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CYCLICAL RAINFALLS AT *Lisbon.*

BY PLINY EARLE CHASE.

Read before the American Philosophical Society, Aug. 18, 1871.

The more strongly marked and decisive character of the curves of lunar monthly rainfall, in Philadelphia than in Great Britain, (*ante* v. x., pp. 523–34,) rendered me desirous of obtaining observations from some European station in lower latitude. The intimation of that desire to the Director of the "Observatorio do Infante Dom Luiz," at Lisbon, was promptly followed by the transmission of a copy of observations extending over a period of sixteen years, which is herewith presented. I also submit some of the tabulated results of such discussion of the observations as I have already undertaken, which appear to me to corroborate, in a most satisfactory manner, the views I have hitherto advanced respecting the meteorological influence of the moon. Some of the tables also afford interesting indications of a somewhat similar planetary influence, sufficient, as it seems to me, to encourage further investigation.

One of the objections most often urged against the acknowledgment of

TABLE I.

Different and non-correspondent Rainfalls at Lisbon, in Lunar and Solar periods. from December 1, 1854, to December 1, 1870. R.=Total fall; N.=Normal percentage of rain.

☽ DAY OR ☉ YR. ÷ 30.	LUNAR MONTHLY.							SOLAR YEARLY.						
	Dec. Mar.		Apl. July.		Aug. Nov.		Yr.	1855+3N*		1856+3N*		1857+3N*		Av.
	R.	N.	R.	N.	R.	N.	N.	R.	N.	R.	N.	R.	N.	N.
1......	298.0	123	45.9	82	154.5	95	106	184.7	102	275.7	192	238.9	160	146
2......	223.9	115	79.7	89	143.1	104	106	120.7	121	329.7	186	112.6	143	148
3......	174.8	97	53.5	94	156.5	103	99	216.8	158	139.9	161	121.8	131	152
4......	136.9	85	63.6	97	124.4	93	90	451.3	192	176.4	138	161.4	130	158
5......	153.5	83	75.9	98	104.9	81	85	342.9	194	193.6	127	109.0	135	156
6......	189.8	81	68.3	96	66.3	78	83	257.4	164	94.0	123	192.9	133	142
7.....	141 8	78	42.9	94	113.5	89	84	224.0	121	242.6	119	131.1	116	119
8......	106 7	78	88.8	93	181.1	102	89	69.5	87	102.2	112	92.2	94	97
9......	187.2	85	37.4	96	118.0	104	93	106.0	75	118.5	109	16.7	91	90
10......	182.9	95	83.1	102	168.9	98	98	130.6	70	164.3	110	147.6	114	95
11......	185.3	108	67.7	109	74.0	98	105	112.5	69	200.7	99	191.8	132	95
12......	252.0	121	83.3	116	111.7	114	118	118.9	59	33.8	75	168.8	118	80
13......	269.8	128	71.6	121	267.0	132	128	78.8	42	84.0	49	33.7	81	55
14......	271.7	124	113.0	118	187.0	133	126	11.2	23	36.8	31	64.9	49	32
15......	173.1	118	46.2	107	118.7	122	118	6.8	11	5.3	17	12.3	25	17
16......	214.7	119	73.2	101	146.9	122	117	15.8	7	16.4	9	5.2	12	9
17......	272.6	128	53.5	107	195.1	134	126	7.9	6	1.8	7	5.9	7	7
18......	260.8	135	89.5	123	204.1	141	135	6.5	7	0.0	8	0.0	12	9
19......	266.0	136	102.9	138	207.5	132	135	12.9	12	33.2	11	11 1	26	16
20......	289 8	124	97.3	145	135.5	114	124	27.6	23	2.1	22	86.1	39	27
21......	199.1	101	105.7	135	98.9	98	106	52.1	45	20.8	50	35.3	46	47
22......	99.3	75	91.7	108	163.9	87	85	93.5	83	118.6	97	35.7	54	80
23......	105.1	60	30.1	74	69.5	77	68	231.2	129	261.2	135	63.5	72	116
24......	97.2	57	12.0	58	84.0	72	62	342.7	166	223.1	150	148.0	92	141
25......	123.2	64	42.4	64	120.7	72	67	304.1	192	157.6	142	74.8	109	153
26......	112.3	76	67.5	82	65.4	77	77	208.5	212	152.3	134	140.4	135	166
27......	244.7	87	61.6	94	134.4	82	86	625.4	216	226.5	131	143.2	174	177
28......	118 7	95	79.6	94	124.2	83	91	275.6	182	101.5	134	341.4	200	171
29......	219.1	105	52.0	86	102.7	81	93	85.9	131	214.0	150	177.8	195	154
30......	214.7	118	44.5	79	71.4	84	100	177.3	104	218.6	174	143.5	177	146

* 1855, '58, '61, '64, '67, '70; 1856, '59, '62, '65, '68; 1857, '60, '63, '66, '69

any appreciable lunar or planetary influence upon rainfall or other atmospheric phenomena, is based on the different, and sometimes contradictory, results obtained by different investigators, from observations in different places and at different times; another arises from the difficulty of conceiving any tidal or other force adequate for the production of any considerable disturbance. Nevertheless, such of the objectors as are familiar with Howard's discussion of the moon's influence upon the barometer; Sabine's, of lunar disturbances of terrestrial magnetism; or Schwabe's and Wolf's, of the dependence of sun-spots upon planetary configurations, seem to admit—at least I am not aware that any of them deny—the probability of the conclusions which those eminent observers have severally expressed.

If it is conceivable that Saturn, Jupiter and Venus can in any way affect the cloudiness, or amount of spotted surface of the the sun, notwithstanding the immense preponderance of his attractive, magnetic and other supposable forces, it is surely much more easy to imagine that they may similarly affect the meteorologic phenomena of the earth, which opposes an antagonizing mass only $\frac{1}{326800}$ (according to Newcomb's estimate) as great as that of the sun. If the lunar tides of our atmosphere are of sufficient magnitude to affect the barometer, the consequent waves must effect a blending of aerial currents of different temperatures and

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TABLE II.

Correspondent Rainfalls at Lisbon, in Lunar and Solar periods.

☽ DAY OR ☉ YR. + 30.	LUNAR MONTHLY.							SOLAR YEARLY.						
	1855–60.		1861–65.		1866–70.		Av.	1855–60.		1861–65.		1866–70.		Av.
	R.	N.	R.	N.	R.	N.	N.	R.	N.	R.	N.	R.	N.	N.
1	115 0	87	170.1	97	178.7	141	104	222.4	131	298.2	150	178.7	171	146
2	146.8	85	154.2	95	151.9	144	103	235.6	148	208.5	144	118.9	155	148
3	116.2	84	134.3	90	150 4	133	98	231.0	162	78.6	145	168.9	146	152
4	108.4	85	147 0	83	96.6	117	91	369.9	162	290.0	162	129.2	148	158
5	158.7	87	106.3	76	119.0	101	86	218.5	142	283.5	175	143.5	154	156
6	124.7	87	108.0	73	84.7	86	81	103.1	119	236.7	163	204.5	150	142
7	102.9	90	102.8	77	69 6	73	81	223.8	108	226 9	128	147.0	126	119
8	158.2	99	172.8	83	53.4	66	85	162.3	105	51.6	89	50.0	96	97
9	173.5	112	93.3	87	76 0	66	91	126.6	101	73.9	71	40.7	95	90
10	162.4	126	180.3	93	73.3	69	94	209.6	97	98.6	76	134.3	118	95
11	231 9	139	120.1	103	50.9	79	110	124 2	88	140.9	85	239 9	124	95
12	235.5	145	193.6	117	98.1	99	123	111.8	74	163.5	79	46.2	91	80
13	205.2	140	264 1	124	164.5	118	128	112.5	59	52.6	56	31.4	47	55
14	216.2	128	153.6	118	102.9	125	123	75 8	40	31.4	31	5.7	21	32
15	118.1	119	152.3	109	154.8	121	116	3.9	22	11.8	15	8.7	12	17
16	194.4	121	193 6	105	91.3	116	114	15.8	10	7.7	7	13 9	10	9
17	199.1	130	136.6	108	117.6	118	118	.8	5	6.2	5	8.6	12	7
18	202.7	133	165.9	119	114.7	128	127	.3	7	.1	7	6.1	15	9
19	239.2	123	246.6	135	176.8	137	131	21 2	14	1.5	15	34 5	20	16
20	120.4	102	234.4	141	144.6	127	123	38.2	24	68.6	26	9 0	31	27
21	104.9	81	251.9	128	113.0	99	104	49.4	40	22 0	47	36.8	51	47
22	117.3	65	135.3	105	40.3	69	82	76.9	79	60 8	86	110.1	72	80
23	60.8	55	92.5	91	29.4	55	69	218.4	124	261.7	136	75.8	79	116
24	58 6	56	158 0	90	70.8	56	70	350.6	159	254.0	171	109.2	73	141
25	87.8	70	182.3	93	78.8	59	77	215.7	179	312.1	176	8.7	79	153
26	175.8	86	112.8	91	28.3	65	84	298.5	194	156.8	165	45.9	124	166
27	149.2	93	143.4	90	72 4	81	89	458.0	191	238.4	156	298.7	185	177
28	96 8	93	148.9	91	133.2	103	95	223 6	163	233.9	149	261.0	211	171
29	180.4	92	145.5	93	129 8	118	99	134.8	130	177.9	143	165.0	200	154
30	121.2	90	141.2	95	97.9	130	102	179.3	121	141.4	145	218.7	185	146

different degrees of humidity; and in consequence of the stratification of the upper and lower winds, this blending offers a unique opportunity for the practical study of the opposite tidal tendencies in deep and shallow fluid seas or envelopes. If the lunar are as unmistakable as the solar modifications of magnetic phenomena, the analogies which have been pointed out, by Messrs. Baxendell and Bloxam between magnetic and pluvial and by myself between pluvial and auroral curves, are indicative of other possible lunar influences which are equally unmistakable. If the difficulty of conceiving an adequate cause for a supposed phenomenon were to deter us from inquiring whether an apparent dependence were real or illusory, all progress in science would become impossible. Finally, if it can be shown that solar rain-curves exhibit different, and often contradictory inflections, similar to those which are objected to in the lunar curves, and if a consistency of disagreement can be shown between the lunar results at two given stations, accompanied by a consistency of agreement between the results in different cycles at the same station, the argument from apparent contradiction will be deprived of all its force.

I have no hope of thoroughly convincing any one who is skeptical of lunar influence on the weather by deductions from observations at one or two, or a half dozen stations, but I believe that any one who will examine, carefully and impartially, the tables I have already published, based on observations in India, Great Britain, Portugal, Canada and different portions of the United States, will at least be willing to admit

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TABLE III.

Lisbon Rainfall in Synodic years of Jupiter.

SYN. YR. ÷ 30.	1853–60.	1861–65.	1866–71.	Dec. Mar.	Ap'l. July.	Aug. Nov.	YEAR.
1	141	177	45	139	70	110	117
2	127	148	41	121	74	93	103
3	111	101	49	87	78	90	86
4	98	65	70	62	79	94	76
5	89	48	99	61	78	97	76
6	81	43	128	70	80	96	81
7	79	43	146	78	89	102	88
8	88	45	151	84	96	112	96
9	110	45	150	95	97	117	103
10	139	45	143	106	103	112	108
11	156	44	141	105	121	121	113
12	146	39	154	90	137	143	116
13	119	36	165	77	133	151	112
14	99	37	146	74	115	124	98
15	99	37	112	83	94	81	84
16	108	36	100	100	89	51	81
17	109	45	114	113	104	46	88
18	96	68	132	117	125	60	99
19	80	98	138	121	131	79	108
20	67	123	127	126	115	85	110
21	53	131	101	107	91	79	99
22	45	129	73	95	78	76	86
23	53	134	58	79	87	91	84
24	72	153	58	79	111	112	96
25	84	168	60	95	127	114	107
26	83	196	60	117	123	99	112
27	86	200	61	128	110	93	113
28	106	191	64	125	100	110	115
29	132	183	61	124	90	130	120
30	145	183	53	133	76	130	122

that the question is an open one. And if he will compare my previous tabulations with those which accompany the present paper, he may, perhaps, find any lingering skepticism shaken, however prejudiced or inveterate it may be.

For convenience of comparison, I represent, in each instance, the mean rainfall for the entire period under consideration by 100, and any deviation from the mean, whether of excess or deficiency, is denoted by the addition or subtraction of a corresponding percentage. The smoothing by successive means is uniform in all the tables. I invite special attention to the columns of lunar rainfall at Lisbon, in each of the first two tables, representing two different sets of three independent periods, averaging 64 months, a cycle which I have hitherto supposed too short to yield any satisfactory results. If there is no causal nexus, it is difficult to imagine any possible reason for the striking similarity between the ordinates for the different cycles, a similarity which I think quite as striking as that between the solar curves at the same station for independent periods of similar duration. If the lunar disturbances are considered as merely tidal, while the solar are partly tidal, but principally thermal, their relative magnitudes suggest interesting comparisons between centrifugal and centripetal forces, analogous to those which I have hitherto had the honor of presenting to the Society.

The resemblance between the independent curves in Table III. is not very marked ; but the yearly mean is curiously like the yearly averages of the lunar monthly ordinates in Tables I. and II., if we construct the curves so as to compare the ordinate of Jupiter's opposition, No. 16, with the ordinate of lunar conjunction, No. 1, and *vice versâ*.

TABLE IV.

Comparative Daily and Yearly Rainfalls.

☉ H., OR YR. ÷ 24.	PHILADELPHIA.						GREENWICH.			
	June.	Dec.	April.	Oct.	Averge Daily.	Ave'ge Annu'l.	Jan.	July.	April.	Oct.
1	123	92	120	114	91	92	53	92	120	99
2	111	78	130	112	91	89	54	103	143	126
3	92	72	127	103	93	89	63	107	169	148
4	77	71	118	97	98	90	66	112	179	146
5	69	71	103	106	105	91	64	118	155	122
6	71	73	86	105	110	94	65	129	110	98
7	79	81	77	105	113	99	72	139	74	82
8	84	95	78	110	113	105	74	140	60	75
9	80	102	78	125	112	110	72	136	59	79
10	68	96	70	140	109	113	78	133	63	85
11	56	87	64	143	105	112	99	128	65	82
12	55	85	67	135	102	110	127	109	66	72
13	66	90	74	117	103	109	141	89	72	65
14	92	100	82	93	106	111	131	94	86	66
15	131	116	94	71	109	112	111	126	101	76
16	172	136	111	58	108	108	97	148	115	97
17	186	144	124	55	104	101	98	129	125	121
18	162	133	124	56	98	95	116	88	124	133
19	123	113	122	65	92	91	145	56	111	129
20	98	102	125	79	87	95	170	40	90	121
21	90	106	123	97	85	96	173	30	73	112
22	92	119	106	106	87	96	150	32	66	98
23	102	124	93	107	90	96	110	49	76	85
24	118	112	101	109	91	95	72	73	98	84

The tendency to opposition between rainfall curves on opposite sides of the Atlantic, of which I have already submitted some illustrations to the Society (*ante*, p. 38, &c.), is interestingly shown near the solstitial and equinoctial periods, by Table IV.* Columns 6 and 7 of the same table indicate a similarity between the curves of daily and annual rainfall at Philadelphia, which lends additional interest to my comparison of pluvial and auroral curves (*ante*, pp. 121–22).

EXPLANATION OF FIGURES.

The horizontal lines represent the average rainfall; each vertical space represents a deviation of .2 of the mean value; each horizontal space represents two days in the abscissas of the lunar curves, or $\frac{1}{15}$ of a year in the abscissas of the solar curves. The lunar curves begin and end with the day of new moon; the solar curves with January 1.

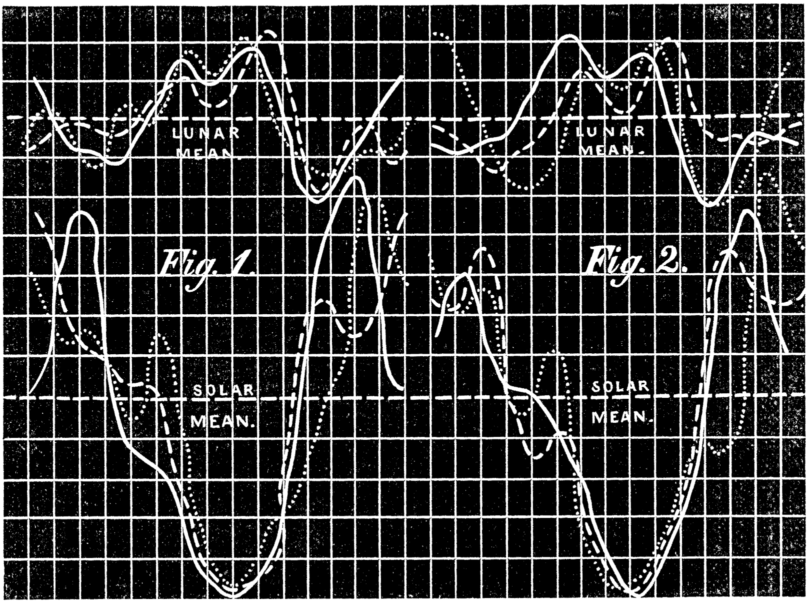

Fig. 1.—*Lunar Curves.*

December to March, inclusive; continuous line.
April to July, inclusive; broken line.
August to November, inclusive; dotted line.

Solar Curves.

1855, '58, '61, '64, '67, '70; continuous line.
1856, '59, '62, '65, '68; broken line.
1857, '60, '63, '66, '69; dotted line.

Fig. 2.

1855–'60; continuous line.
1861–'65; broken line.
1866–'70; dotted line.

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* Published by permission of Prof. Benjamin Peirce, Supt. U. S. Coast Survey.

LISBON RAINFALL.

Dec. 1, 1854, to Dec. 1, 1855.

Day.	Dec.	Jan.	Feb.	Mar.	Ap.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Total
1			4.3			4.3	0.8				16.5	0.3	26.2
2			26.7		0.5	1.1					1.5		29.8
3	1.9		2.2	0.5		14.3				2.2	0.4		21.5
4	4.9		8.1	19.5		3.2				13.2	8.9		57,8
5			8.6	2.7		2.3				1.3			14.9
6	0.5		5.7			0.3					7.6		14.1
7			0.5	4.0			0.3			0.6	16.2		21.6
8			3.5	3.3						8.6	6.5		21.9
9			7.6	1.3						2.4	52.8	4.4	68.5
10			8.9					13.2		0.5	2.2	1.5	26.3
11			2.4								0.3	0.1	2.8
12			27.0										27.0
13		0.5	23 8		0.2						13.0		37.5
14		0.3	3.5		2.2						13.5		19.5
15			8.6		0 3	0.3					2.7	0.7	12.6
16		0.6	24.6		16.2	1.1							42.5
17		0.8	2.5		8.1						17.0		28.4
18		3.0	19.2		0.3						6.3	2.3	31.1
19		2.4	7.3		4.3					0.3	0.3	10.7	25.3
20			6.0	3.5									9.5
21				6.2	11.1							16.4	33.7
22		0.5	14.3	4.6	3.8					20.0	11.9	10.9	66.0
23			0.8	6.5	0.5					0.8	9.2	13.0	30.8
24				15.9							0.6	1.0	17.5
25			0.5	2.7	8.1	5.6							16.9
26		17.3		18.9		31.3				8.4			75.9
27		19.7		27.2		3.0			0.8	0.5	5.0		56.2
28		1.1	0.5			7.3				4.0	4.0		16.9
29		9.7		9.2		14.6				30.5		6.6	70.6
30				0.5		0.8		0.3		0.8	0.8	2.0	5.2
31						1.1					1.3		2.4
Sum	7.3	55.9	217.1	126.5	55.6	90.6	1.1	13.5	0.8	94.1	198.5	69.9	930·9

Dec. 1, 1855, to Dec. 1, 1856.

Day.	Dec.	Jan.	Feb.	Mar.	Ap.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Total
1		8.5	16.8		6.2	6.1							37 6
2		7.3	3.3		3.2						0.8		14.6
3		30.6	6.9		0.8						0.6		38.9
4		3.6			9.9					1·3	0.4		15.2
5		28.3			3.8					0·1	50.9		83.1
6		9.4			0.3					0·1	4.1		13.9
7	3.6	12.9		7.7									24.2
8		12.9		3.8	11.8						1.1		29.6
9		12.9		0.2	2 4							1.5	17.0
10	1.0	11.4		1.1	0.9								14.4
11	1.6	6.2		2.6									10.4
12				6.0	6.7							1.9	14.6
13		0.8	10.8	1.5	7.6						3.5		24.2
14		0.3	5.1	11.7	0.7								17.8
15		6.2	6.8	5.4	6.2								24.6
16	0.7	11.3	1.7	43 4									57.1
17	6.7	0.8	7.0	26.5	0.3				1.0				42.3
18	4.9	40.9	3.4	12.1					6.2			0.7	68.2
19	0.8	18.7	16.8		0.7								37.0
20	27.5	8.4	1.8		0.3				1.3				39.3
21	3.4	11.7	1.1			1.1							17.3
22		0.5											0.5
23	0.3	1.6	18.3	0.3		2.3							22.8
24	0.8	6.3		4.1	16.5	1.5				4.3			33.5
25	3.7	24.8			6.0	0.3							34.8
26	5.8	7.9		18.9	35.9								68.5
27	46.8	3.9		5.5	6.8					9.2			72.2
28	1.9	3.5		0.6	1.3	1.2				0.1			8.6
29				0.5	3.6	4.4				4.3		0.1	12.9
30													
31	12.5										5.3		17·8
Sum	122.0	291.6	99.8	151.9	131.9	16.9	0.0	0.0	8.5	19.4	66·7	4.2	912.9

LISBON RAINFALL.

Dec. 1, 1856, to Dec. 1, 1857

Day.	Dec.	Jan.	Feb.	Mar.	Ap.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Total
1				2.4	7.9		3.6				3.2	17.7	34.8
2	5.0		8.3	0.6		0.3		0.2			0.9	6.5	21.8
3	8.5	1.3	5.0		0.7	1.0						27.6	44.1
4	0.1	1.3	0.2		1.3							5.2	8.1
5	10.5	0.4			0.3							10.6	21.8
6	3.0	7.6				0.5							11.1
7			0.1	1.1		1.1					7.6		9.9
8	0.7		6 6	1.1		0.7				0.2			9.3
9	20.7		39.5		3.5	1.3				1.0			66.0
10	6.7		30.0		1.1	14.9				1.0		1.8	55 5
11	0.9	1.4	12.2	1.3									15.8
12	2.0	6.5	0.2										8 7
13	11.3	4.8	0.5	3.2		0.7							20.5
14	0.5		3 5	0.1	0.1	0.7							4 9
15			1 2		0.2		0.6					4.3	6.3
16			6.2				10.0					28.9	45.1
17			1.9	4.3			15.6					11.5	33.3
18				7.4			4.8				12.0		24.2
19			5.1								17.5		22.6
20		0.3	1.7	17.3						5.9			25.2
21	5.0	9.2		0.2		1.7				2.0			18.1
22	1.5					1.9			0.7	1.0			5.1
23		0 5	0.2			10.4			25.9			28.0	65.0
24		8.1	0.7	11.1		26.0				0.3	4.3	0.6	51.1
25	0.5	6.5		0.2		1.5				3.2	19.9	12.0	43.8
26	8.9	1.2			0.2	2.4					11.0	1.0	24.7
27	0 9	0.5				2.1					0.9		4.4
28	2 6			1.1					0.3			21.5	25.5
29									6.2		1.4	35.4	43.0
30				12.2	0.7					3.1		11.4	27.4
31		5.8		5.4							4.0		15.2
Sum	89.3	55.4	123.1	69.0	16.0	67.2	34.6	0.2	33.1	17.7	82.7	224.0	812.3

Dec. 1, 1857, to Dec. 1, 1858.

Day.	Dec.	Jan.	Feb.	Mar.	Ap.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Total
1				30.5	0.3	0.2		0.1					31.1
2				15.0	0.2	0.7							15.9
3	21.1			6.8		0.2							28.1
4	0.4	8.8	2.5	7.5		5.0						17.3	41.5
5			7.5		0.6							0.8	8.9
6			0.6										0.6
7		4.8	5.7		4.8								15.3
8			0.3		3 3							1.2	4 8
9			8.1		1.4	5.0						40.5	55 0
10			8.5			6.0					12.6	37.2	64.3
11			10.0			2 9					0.1	0.4	13.4
12			18.3	1.8	2.5	0.2						20.4	43.2
13			0.8									7.8	8.6
14												4.7	4.7
15						2.0						55.9	57.9
16										0.6		0.6	1.2
17			12.0								21.5	6.7	40.2
18			17.6				0.2		2.6		7.5	60.9	88.8
19	13.8										30 5	0.8	45.1
20			4.0							29.3	2.3	10.2	45.8
21			20.8	0.2						8.2		3.7	32.9
22			14.7								1.9	22.0	38.6
23			1.9	8.4							17.1	22.8	50.2
24			67.						1.1		7.9	26.9	42.6
25			0.6						0.2			27.9	28.7
26		9.6	6.2									14.6	30.4
27		8.7	4.0							6.6		6.3	25.6
28			6 2							7.0		2.0	15.2
29							2.9					9.7	12.6
30				2.0								13.2	15.2
31				5.7									5.7
Sum	35.3	31.9	157.0	77.9	13.1	22.2	3.1	0.1	3.9	51.7	101.4	414.5	912.1

LISBON RAINFALL.

Dec. 1, 1858, to Dec. 1, 1859.

Day.	Dec.	Jan.	Feb.	Mar.	Ap.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Total
1			0.5			2.2	9.0						11.7
2	0.3		0.2			0 3	8.3						9.1
3	0.5					3.8	1.3					9.8	15.4
4						23.3	1.2				1.5	20.3	46.3
5			2.9			1.0	4.4				0.6		8.9
6			2.0			0.6	12.2				9.6		24 4
7			6.0				13.8				0.8		20.6
8			0.5				3.4				19 3		23.2
9							3.9				4.2		8.1
10			13.6		0.3						0 8		14.7
11			0.5		0.2						20.0		20.7
12			0.2			19.1	7.9				40.7		67.9
13	9.8					10.7	0.8				13.0	1.5	35.8
14				0.5			1 4				6.2		8.1
15							2.9			0.4	12.2		15.5
16	25.4												25.4
17	2.0					0.1				0.4	9.3		11.8
18	13.7				28.1				0.3		0.5		42.6
19	1.9				19.3			0.8					22.0
20	1.2				5.3	6.6						20.7	33.8
21		1.8			4 2						5.1	9.5	20.6
22		17.3			3.3	2.7					11.0	4.2	38.5
23	15.0	0.3			0.1						1.6	0.5	17.5
24	3.1				1.0							8.7	12.8
25											23.0		23.0
26		0.2			0.3							0.1	0.6
27					18.0						17.0	0.8	35.8
28	0.2	0.1			0.4	1.7				1.0	31.7		35.1
29				4.1	19.9	3.4							27.4
30		5.5		1.0	4.2	12.4					0.6		23.7
31		3.3				3.7					0.3		7.3
Sum	73.1	28.5	26.4	5.6	104.6	91.6	70.5	0 8	0.3	1.8	229.0	76.1	708 3

Dec. 1, 1859, to Dec. 1, 1860.

Day.	Dec.	Jan.	Feb.	Mar.	Ap.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Total
1	0.4	2 5	0.1		14.3					2.7		2 1	22.1
2		12.6					1.3			6 3		1.7	21.9
3	14.4	7.7			12.1								34.2
4		2.4			7 7							0.6	10.7
5		6.3			1.8								8.1
6	5.1	3.2			0.4							12.5	21.2
7				4.4								3.6	8 0
8	11.2	0.5	3.9									1.5	17.1
9		0.4	2.9				4.7	2.5		6.3		2.4	19.2
10		1.9										23.5	25.4
11				2.4						1.6		9.8	13 8
12		1.6	0.3	2.0		2.1	1.5					1.0	8.5
13		37.1		1.3			3.5					14.8	56.7
14		0.3				2.7						0.2	3.2
15				0.1			5.2		10.1			7.2	22.6
16		4.7										14 8	19 5
17		4.6			2.1	0.7						4.9	12.3
18		12.6			1.0	12.2				0.8		1.5	28.1
19		0.4					7.0					1.2	8.6
20		6.1					3.8					3.1	13 0
21		0.2											0.2
22		3.7	2.4									1.0	7.1
23	0.5	0.9										1.2	2.6
24	0.3	2.0	4.5							0.5		1.2	8.5
25	22.6	0.6	12.7		30.9							5.7	72.6
26		0.2			15.5							4.9	20.6
27	3.7	2.3	0.5							12.0		6.4	24.9
28	4.6			5.1						1.2	3.8	9.4	24.1
29	3.2										7.7	5.4	16.3
30	0.1	0.6										2.8	3.5
31		2.1		3.6									5.7
Sum	66.1	117.5	27.3	18.9	85.8	17.7	27.0	2.5	10.1	31.4	11.5	144.4	560.2

LISBON RAINFALL.

Dec. 1, 1860, to Dec. 1, 1861.

Day.	Dec.	Jan.	Feb.	Mar.	Ap.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Total
1	17.4										1.6	0.3	19 3
2	23.4					1.0					12.6		37.0
3	12.1	6.2									9.2		27.5
4	4.4	0.4											4.8
5	4.3	15.4						0.5					20.2
6	15.8	1.0	3.2								4.8		24.8
7	28.5		15 4								1.6		45.5
8	17.5		3.0			7.2						16.4	44.1
9	1.2		43.3										44.5
10	2.6		19.7				2.7				25.7	14.0	64.7
11	1.2		0.2							2.9		2.8	7.9
12			4 8								0.8	5.9	10.7
13	2.6		2.1									6.1	10.8
14	0.3	6.1	31.5				0.2	2.6			5.2		45.9
15		20.5	5.6		5.7						36.3		68.1
16		2.0	1.1			16-3	1.2				10.8	7.2	38.6
17			18.5			7.3	4.2					15.8	45.8
18	1.3		29.9			6.4						4.8	42.4
19	0.8		3.3		1.3						3.8	1.4	10.6
20			7.1		9.4	2.6						31.6	50.7
21	6.0		2.6		4.0						1.3	6.6	20.5
22	10 4		28.7		1.6						0.1		40.8
23	6.4		3.7			2.8	2.8						15.7
24	30.3		0.2		4.0					2.4		0.4	37 3
25	14.6									3.7		4.4	22.7
26	0.3		2.9		0.6	6.0		0.4			14.0	1.2	25 4
27	7.1			13.8		24.7					6.8		52.4
28	13.6			1.0	31.8	5.6					22.5		74.5
29	1.0				1.0	0.2					4 9		7.1
30										15.0			15.0
31											6.5		6.5
Sum	223.1	51.6	226.8	14.8	59.4	80.1	11.1	3.5	0.0	24 0	168.5	118.9	881 9

Dec. 1, 1861, to Dec. 1, 1862.

Day.	Dec.	Jan.	Feb.	Mar.	Ap	May.	June.	July.	Aug.	Sept	Oct.	Nov.	Total
1		2 2		23.5		0.3							26.0
2		19.6		13.5	0.9								34.0
3		1.4		13.1		5.3							19.8
4		0.9				4 6							5.5
5						5.3		5.3					10.6
6				4.2									4.2
7	0.2			17.7		0.4							18.3
8		3.2		1.5									4.7
9	1.7	0.8		12.6						2.7			17 8
10	6.7										1.5		8.2
11		1.5			0.1		0.2					1.0	2.8
12		1.3			11.0								12.3
13	24.2	0.9			2.2								27.3
14	1.0												1.0
15			17.1		2.3	14.8	0.5			4.8	8.5		48.0
16		0.2	15.5	22.8									38.5
17			16.3										16.3
18		2.1	35.7	13.1									50.9
19		5.1	34.9	31.5							2.2		73.7
20	1.4	25 8	0.7	9.5								9.4	46.8
21		0.4	17.6										18.0
22		4.9								14.2		2.5	21 6
23	3.2	32.2										17.4	52.8
24		1.6	19.6	15.5	0.6					8.3		16.1	61.7
25		0.4		5.6						0.6		0.2	6.8
26			14.7	4.9		0.8				0.2		1.4	22.0
27	15.8	11.4	17.6	10.2			0.6			5.8		27 2	88.6
28	3.4		0.2	6.3	0.1							8.8	18.8
29				5.3		0.3						6.2	11.8
30	1.0			17.4	3.3	2.4				4.2		14.7	43.0
31											19.0		19.0
Sum	58.6	115.9	189.9	228.2	20.5	34 2	1.3	5.3	0.0	40 8	31.2	104.9	830.8

LISBON RAINFALL.

Dec. 1, 1862, to Dec. 1, 1863.

Day.	Dec.	Jan.	Feb.	Mar.	Ap.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Total
1	6.6												6.6
2	22.1	1.3		4.0								1.6	29.0
3	18.7	24.8	0.3	41.0						1.9			86.7
4		34.4		24.8									59.2
5		2.0		2.1									4.1
6		9.0		12.3									21.3
7		1.1		0.6							1.4		3.1
8		3.0		8.2							1.8		13.0
9		24.2		4 8		0.1	1.8				19.5		50.4
10		1.3		8.0	0.2						11.8		21.3
11				1.2	0.6		4.6				2 2	1.0	9 6
12			4.3	1.1							17.3		22.7
13				7.7	2.2					8.6	1.0		19.5
14				0.1							4.4		4.5
15				1.0									1.0
16				0.5									0.5
17													
18						0 5							0.5
19										1.5			1.5
20						3,4							3.4
21					0.2	17.0		1.8		0.5		1.2	20.7
22						26.0		2.2		0.3			28.5
23						6 6				1.1	0.3	7.2	15 2
24		4.2				17.1				1.4			22.7
25					2.5	2.8	0.2			2.0	2.5		10.0
26							0.6		46.8		5.0		52.4
27									2.6				2.6
28							3.5		0.6				4.1
29	2.5												2.5
30	14.3	5.1								4.6	1.3		25.3
31		2.6									0.2		2.8
Sum	64.2	113.0	4.6	117.4	5.7	73.5	10.7	4.0	50.0	21.9	68.7	11.0	544.7

Dec. 1, 1863, to Dec. 1, 1864.

Day.	Dec.	Jan,	Feb.	Mar.	Ap.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Total
1				9.2			7.0				8.2	0.9	25.3
2											1.3	2.4	3.7
3				0.4			6.6				17.2		24.2
4				18.8			0.6				7.0		26.4
5				0 4									0.4
6				17.0							2.8		19.8
7		24.0	0.4	17.3		4.0					13.0		58.7
8		0.6	9.3	1.5		0.8							12.2
9		20 3	6 1	14.4		12.0					4.9	0.4	58.1
10			3.4	1.5		3.4						5.0	13.3
11		3.8			0.1								3.9
12		21 1			6.5								27.6
13					7.2								7.2
14					4.2		2.7	0.2				3.0	10-1
15					5.9					0.2		0.2	6.3
16		3.2			0.4					15.8		0.2	19 6
17		1.9		0.5							0.9	12.6	15.9
18				19.0						0.4	16.5		35.9
19				13.5							3.5	11.0	28.0
20				15.1	5.9						9.4		30.4
21				6 7	11.3						32.1		50.1
22			4.1	0.2	4.2				16.8		7.5		32.8
23			9.9	31.0	4.3						17.3	12.3	74.8
24			16.8			12.0					27.5	4.0	60.3
25			3.3	5.9		7.0					5.8	6.0	28.0
26			8.6		7.5	10.5				0.1	28.1	1.7	56.5
27			10.3	1.1						9.2	7.8		28.4
28			0.3							14.9	11.3	0.3	26.8
29			7.1								0.2		7.3
30										0.2	30.1		30.3
31	0.8					1.5					10.3		12.6
Sum	0.8	74.9	79 6	173.5	57.5	51.2	16.9	0.2	16.8	40.8	262.7	60.0	834.9

LISBON RAINFALL.

Dec. 1, 1864, to Dec. 1. 1865.

Day.	Dec.	Jan.	Feb.	Mar.	Ap.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Total
1		9.0	7.9	0.1			2.3						19.3
2		0.5	3.5				0.4						4.4
3		0.1	4.4								11.1	0.8	16.4
4			4.1			2.2					16.2		22.5
5			0.8			11.4					0.6	5.6	18.4
6			5.0	1.1		11.2					50.6	6.0	73.9
7			10.4			26.4					35.7		72.5
8	9.1	1.7	6.5			11.0					30.7		59.0
9	6.2	22.1				6.9					11.0	60.6	106.8
10	3.6	0.4								10.2		19.5	33.7
11	11.9	1.6			1.0		0.2						14.7
12	3.2	37.8							1.0		3.3	11.2	56.5
13	31.2	0.5				25.9					2.1	1.1	60.8
14	23.8	1.2		0.4	6 9	3.0			0.5				35.8
15		0.1	1.9		3.6	3.1							8.7
16	5.6	4.8	4.6		3.1								18.1
17	9 6	5.3	1.2	0.1			7.8				0.2		24.2
18	0.7	7.9		13.9			4.3				17.0		43.8
19	2.4			2.7			1.0				0.9	12.0	19.0
20		35.5		6.6				1.0			7.2	1.0	51.3
21		13.4		2.1	4.0		3.4				20.5	8.5	51.9
22		0.1		0.8							8.2	1.9	11.0
23	0.4	18.3							1.6		0.8	15.8	36.9
24	0.4	7.3								0.4			8.1
25		9.3								1.5		41.0	51.8
26		0.8								1.0		2.9	4.7
27		8.8			4.9				0.2		0.1	14.3	28.3
28		2.1			0.8						1.8	7.4	12.1
29		6.0			5.0					2.7	0.8	26.6	41.1
30	7.5						0.7			12.8	2.6		23.6
31	0.9	10.2				1.0					1.0		13.1
Sum	116.5	204.8	50.3	27.8	29.3	102.1	20.1	1.0	3.3	28.6	222.4	236.2	1042.4

Dec. 1, 1865, to Dec. 1, 1866.

Day.	Dec.	Jan,	Feb.	Mar.	Ap.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Total
1		4.6	3.4	9.3		7.3	1.5						26.1
2	3.3		7.4	14.2	3 2		0.7						28.8
3	12.2			13.7	1.2	2.2							29.3
4		6.3		2.2		34.5							43.0
5	5.7	1.9		3.5	9.8	39 5		2.4					62.8
6	14.3				2.4	6.6					1.0		24.3
7	3.6			3.7	0.9								8.2
8				0.5	0.4								0.9
9		0.6	5.3							2.6	0.4		8.9
10		7.0	0.7								7.2		14,9
11		14.4	19.7	1.0									35.1
12			5.9								1.8		7.7
13			2.0										2.0
14			6.5	4.8									11.3
15		0.6		16.4							0.6		17.6
16				11.2								3.2	14.4
17				21.4							17.7		39.1
18			1.6	17.6					1.0		2.9		23.1
19				5.8									5.8
20		9.4		12.9					0.3				22.6
21		1.2		0.3		0,5					7.4		9.4
22		0.4				4.0				4.2			8.6
23	14.6				4.3	23.3	0.2	1.3		7.5			51.2
24						1.7		0.6					2.3
25					1.0	0.8	0.2			0.1		0.9	3.0
26		0.6	10.8		4.5	0.5	0.1						16.5
27		10.0	16.4		23.3	0.7	6.3			3.7			60.4
28			16.0		2.1	6.2				0.3			24.6
29	5.5				32.2	0.5				2.7		8.8	49.7
30	0.8	1.2			1.0					0.3		9.0	12.3
31		0.8				12.2							13.0
Sum	60.0	59.0	95.7	138.5	86.3	140.5	9.0	4.3	1.3	21.4	39.0	21.9	676.9

LISBON RAINFALL.

Dec. 1, 1866, to Dec. 1, 1867.

Day.	Dec.	Jan.	Feb.	Mar.	Ap.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Total
1								0.3	5.9				6.2
2	6.8											0.2	7.0
3		0.7											0.7
4		4.1											4.1
5	0.2	7.9	0.2										8.3
6	0.1	3.2	1.0	13.3		2.2							19.8
7	0.1	8.1	0.2	26.4		19.1							53.9
8		15.8		5.1									20.9
9	0.3	0.9		2.4		0.4				0.2			4.2
10		19.4		6.3		7.3							33.0
11	0.4	1.9		4.3									6.6
12	0.2	9.2		2.5	0.8	5.4				10.1		18.9	47.1
13		1.6		14.9	1.8	5.4				0.9	0.4	12.6	37.6
14		2.5		12.0		1.4					5.2	54.4	75.5
15		1.2	2.9	0.6		0.8						48.8	54.3
16			22.7	0.2								6.2	29.1
17		23.4		5.6							0.2	12.5	41.7
18		7.8		12.7		2.2					0.2		22.9
19		14.0		12.3		0.1							26.4
20		18.9			7.2	0.1	0.7						26.9
21		0.1		5.6								0.1	5.8
22		1.4											1.4
23				6.9									6.9
24		7.5		0.7				0.3					8.5
25				1.3		4 3		6.4					12.0
26	0.8			11.2									12.0
27	4.6			5.2									9.8
28				1.4	1.0								2.4
29				2.8		2.2							5.0
30					0.8							1.2	2.0
31	7.1												7.1
Sum	20.6	149.6	27.0	153.7	11 6	50.9	0.7	7.0	5.9	11.2	6.0	154.9	599.1

Dec. 1, 1867, to Dec. 1, 1868.

Day.	Dec.	Jan.	Feb.	Mar.	Ap.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Total
1	24.0				2.4						1.8		28.2
2					0.7								0.7
3					17.5			0.1					17.6
4					0.4	27 6		4.3			4.9		37.2
5					2.0	0.6							2.6
6		10.5										3.9	14.4
7													0.0
8		0.8	20.0				0 3						21.1
9	3.4	0.5		2.0			0.1						6.0
10		0.3				0.6						9.3	10.2
11		13.7		3.0				4.8	0.4	4.2			26.1
12						0.2		1.9	2.8	0.5			5.4
13		8.3								3.3	0.7		12.3
14										12.7	5.9		18.6
15									9.7	0.2	0.8	15.8	26.5
16									1.9	15.6		7.0	24.5
17	0.1									0.4		14.6	15.1
18	0.2						2.7		8.4	22.5	2.0	3.0	38.8
19		5.0	2.4		5.4					5.2			18.0
20		4.5			4.0					12.4		1.0	21.9
21					0.4		0.1			1 6		2.2	4.3
22		5.8	0.8		3.5					0.7		24.3	35.1
23		0.3			4.8		0.2					2 0	7.3
24	4.4				1.8					8.5		0 5	15 2
25	16.4											9.8	26.2
26										7.5		3.5	11.0
27			0.3				0.3			2.4		0.4	3.4
28	8									0.8		1.0	10.6
29	2.0									10.4		1.4	13.8
30	15.2									16.4		38.3	69.9
31	15.2												15.2
Sum	89 7	49.7	23.5	5.0	42.9	29.0	3.7	11.1	23.2	125.3	16.1	138 0	557 2

LISBON RAINFALL.

Dec. 1. 1868, to Dec. 1, 1869.

Day.	Dec.	Jan.	Feb.	Mar.	Ap.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Total
1			6.0			0.2					5.0		11.2
2	23.5												23.5
3	0.4	7.7	0.2										8.3
4	5 2				0.2			0.2					5.6
5	1.1					27.9							29.0
6						16.4							16.4
7	0 2					5.4							5.6
8	1.5												1.5
9				3.2		14.9					6.2		24.3
10		12.3	0.1	3.5	1.4	0.2				1.8			19.3
11	5.8	1.3		7.1	0.7					5 6			20.5
12	62.7	17.0				17.9							97.6
13	13.0	0.6		10.7		0.2	2.3						26.8
14	2.3			7.0		0.4	0.3						10.0
15	16 7	1.4		0.1									18.2
16		0.2		1.1	3.3							1.0	5.6
17	15.8		1 3								14.1		31.2
18	0.2		8.2								7.6		16.0
19	3.2		0.5								0.5		4.2
20	15.5					0.3				1.0			16.8
21	2.8		7.0	1.1									10.9
22	5.8	1.0										1.5	8.3
23	0.2	0.8										4.1	5.1
24	13.3	2.0		0.3								1.3	16.9
25	3.0			0.4	0.5	3.9							7.8
26		17.7		0.4	0.2	3 4							21.7
27	3.4	9.0				0.6							13.0
28	0.3	5.0			1 4	0.7				5.0			12.4
29	6.3	0.2		0.5	19.4	3.2	0.3			9.2			39.1
30	0.3	16 0				0.4				1.9		0.2	18.8
31		5.3											5,3
Sum	202 5	97.5	23.3	35.4	27.1	96.0	2.9	0.2	0.0	24.5	33.4	8.1	550.9

Dec. 1, 1869, to Dec. 1, 1870.

Day.	Dec.	Jan.	Feb.	Mar.	Ap.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Total
1		1.4							0.2				1.6
2		1.0	31.2	21.7							0.2		‘54.1
3	9.2	1.4	6 2	6.6									23.4
4			5.4	11.0			2.5				5.2		24.1
5		0.5		14.0						0.2			14.7
6	9 9	0.6	1.1	0.5		0.8				3.0			15.9
7	5.1		4.0	2.2	0.2					6.4			17.9
8	7.9	1.4	0.9	2 7	0.1						21.3		34.3
9	19.5		2.4	8.4							8.0	2.0	40.3
10		0.5	0.6		5.5						1.2	0.7	8.5
11	3.5		7.5					0.2			3.0	0.2	14.4
12			1.0			3.1					0.2	5.7	10.0
13	1.4	0.3	5.5						0.3			2.4	9.9
14	0.8	0.4											1.2
15	0.4	0.1	1.8								0.3	1.5	4.1
16			9 6										9.6
17	0.2		1.0		0.1				6.7		0.8	6.8	15.6
18					0.4					3.1		0.3	3.8
19	1.5		28.5						3.3	0.6		9.0	42.9
20	19.3				30.6							15.5	65.4
21	7.3									8.9			16.2
22	1.7		1.2									3.0	5.9
23	2.5		0.7								0.5	. 5.9	9.6
24			6.7								0.8	32.6	40.1
25			4.0									10.7	14.7
26	1.4	3 9											5.3
27	1.3	2.3	2.2		3.7							1.8	11.3
28			3.6									1.5	5.1
29		8.8											8.8
30	26.4	3.0							8.7				38.1
31	11.7	24.0											35.7
Sum	131.0	49.6	125.1	67.1	40.6	3.9	2.5	0.2	19.2	22.2	41.5	99.6	602.5